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FOREIGN AND INSULAR.

The antimalarial influence of lime.

[By DR. GRELLET, Laureat of the Academy of Medicine.—Translated in this bureau from reprint from the Revue D'Hygiene, vol. xxi, No. 8, 1899, Paris.]

The communication made to the Academy of Medicine by Dr. Roché, of Toucy, on the disappearance of paludism in Puisaye, and the report of Dr. Laveran on the same subject, led the writer to make the following statements with regard to the antimalarial properties of lime.

The incorporation into the soil of a certain quantity of lime, used as fertilizer, brought about the disappearance of malaria on the plateau of Châtillon-sur-Loing (Loiret). After careful examination of the subject, it is not possible to attribute the disappearance of malarial fever, formerly very prevalent in this locality, to any other cause.

The fertilizing of the soil was resumed in 1824 on the plateau of Chatillon after a long cessation, and has since then been regularly carried on. In 1840 it was practiced on all the estates on the plateau, and from 1840 dates the disappearance of fevers. This disappearance is not attributable to any known cause but the use of lime as a fertilizer. The hygiene of the locality, the methods of cultivation and the agricultural implements in use remain the same; no drainage has been provided and no sanitation has been practiced. The ditches, ponds, and all bodies of stagnant water are in their usual state, but they have ceased to be foci of malarial infection.

In this case what has been the action of the lime? Has it acted directly by destroying, in virtue of its own peculiar properties, the germs of malaria present in the soil by preventing their pullulation? Or has it, by its friability and by the softening process which it sets up in the compact clayey soil, which is the special habitat of malaria, facilitated the action of the sun and oxygen and other powerful destroyers, known and unknown, of pathogenic microbes? To these questions the only reply possible is that lime has caused the disappearance of malarial germs from the estates on which it has been directly applied, and that this effect has extended, little by little, on the plateau with the increased use of lime as a fertilizer. The ponds and pools of standing water, the mire and ooze of which were formerly very pernicious, have become entirely inoffensive. It is possible that they have been rendered sanitary by the calcareous deposits carried into them by the drainage water from the fields. On the other hand, the germ of malaria having a telluric origin, it is possible that these bodies of water have ceased to be receptacles of malaria germs collected formerly by the rain water from the surface of the plateau. Simultaneously with the malarial fever there disappeared a little wild osier which has a peculiar affinity for acid soil and which formerly flourished in abundance on all fallow fields.

The arable soil of Chatillon is clay superimposed on a conglomerate of silica and oxide of iron. This is hard and compact and is as impermeable now as before the disappearance of malaria. Below, at a very great depth, is found a stratum of marl, the edges of which may be discerned on slopes of the plateau. The plateau itself overhangs, at a

height of about 30 meters, a damp, marshy valley, formed of alluvial soil, which would appear, *a priori*, to be a favorable site for malaria. Now this valley has always been spared by the fevers, while the plateau above has been affected. This immunity of the valley is only to be explained by the presence of lime, which is mixed in large proportion with the soil, and by the attrition of the calcareous rock.

To my own knowledge the liming of soil has been practiced, solely in agricultural interests, in various provinces of France which were more or less affected with malaria. Since the practice has become general these provinces have become free from malaria, this result being inexplicable except on the assumption of the influence of lime. The progress of hygiene is not sufficient to explain this change.

Following out this line of inquiry, medical geography shows many countries of the globe which present all the conditions favorable to the development of malaria, but which are yet almost immune. This immunity may, notwithstanding the generally admitted theory in regard to the etiology of malaria, find its true explanation in the agency of lime, at least as regards the countries from which I have been able to obtain data. This is the case with lower Egypt, which, with its periodic inundations, its marshes, high temperature, defective hygiene, etc., would appear to be a sort of promised land for malaria. Far from this being the case, however, Egypt has always been noted for salubrity. If at this time an apparent exception must be made as regards Alexandria and Lake Mareotis, where some intermittent fevers are observed, this peculiarity is explainable by an event relatively recent—the mixture of sea water with fresh water, after the cutting of the dykes of Lake Mareotis by the Anglo Turkish army, April 4, 1801. In former times the health of the country was perfect. Now this salubrity of Lower Egypt undoubtedly results from the mixture of the soil with the deposits from the Nile, which contain a large proportion of lime.

The shores of the Loire and Seine and their estuaries are nearly exempt from malaria. The same general immunity is enjoyed by Beauce, situated on calcareous soil, on the right bank of the Loire. The opposite bank, in the region of the Sologne, which is sandy and clayey and very poor in lime, is strongly affected with malaria, although it is much less damp than Beauce.

On the Channel coast of France the soil is calcareous and exempt from malaria. On the ocean, at the mouth of the Loire, where clay is present and lime rare or altogether lacking, fevers make their appearance.

The basin of the Scheldt consists of granitic and clay formations. At its mouth clay alluvial deposit forms, which is an incessant source of paludal miasma, such as in 1747, 1806, and 1809 played an important part in the military history of England and France. On the contrary, the mouth of the Thames, which is opposite to that of the Scheldt and at only a short distance from it, is relatively free from malaria, in spite of the enormous pollution of the river. The waters of the Thames come largely in contact with calcareous rock.

In Algiers calcareous localities are free from malaria which prevails all around them, especially on clay soil and in a less degree in the granitic and schist region. Here malaria is bound by close relations to geological conditions. It clearly depends on the composition of the superficial strata of the soil, independently of any conditions of altitude, declivity, etc.

The absence or rarity of malaria in Tahiti, New Caledonia, and most of the islands of Polynesia, which are covered with marsh throughout the entire extent of their littoral, and appear to present malarial condi-

tions at their maximum, is a subject for amazement to travelers and physicians. There, again, as in Egypt, salubrity may be attributed to the presence of lime. The geological formations of these islands present a striking analogy; their shores are composed of coral reefs or deposits, that is to say, of lime, with which the coast marshes everywhere come in contact. It is undoubtedly to the action of lime and not to the hypothetical infiltration of sea water, as claimed by some writers, that the innocuousness of the salt marshes is to be attributed.

Many other analogous facts might be cited. In 1898 I pointed out the close relation existing in Algeria between malaria and the chemical and geological constitution of the surface soil. The germ of malarial disease has undoubtedly a telluric origin. It shows a marked preference for certain soil; it separates itself from the superficial strata, and in my observation we may forecast the salubrity of any region as regards malaria, from a knowledge solely of the nature and composition of the superficial soil.

With regard to the quantity of lime to be used it has been found that on the plateau of Chatillon 27,000 kilograms of lime to the acre sufficed for agricultural needs and for the elimination of malaria. It is to be observed that these benefits are not transitory. After seventy years' use they retain their full virtue from the cultural as well as the malarial point of view. The quantity of lime to be used should be regulated by local conditions and the proportion already present in the soil.

In conclusion I would request the academy of medicine to institute an inquiry with regard to the three following propositions:

(1) The immunity more or less complete, as regards malaria of those countries, the soil of which contains naturally in its superficial layers a strong proportion of lime, and which has mud, ooze, and slime rich in calcareous deposit.

(2) The freedom from malaria of the banks of rivers, streams and brooks flowing in calcareous basins.

(3) The relative immunity in malarious regions obtained by the addition of compost and fertilizers, chiefly lime, incorporated with the superficial strata of the soil.

NOTE.—The results of analyses made by Müntz of water taken at Cairo, September 6, 1888, from the middle of the Great Nile and at a depth of 0.60 meters, the level of the stream being 5 meters above low-water mark, are as follows:

	In solu- tion.	In sus- pension.
	<i>Gramme.</i>	<i>Gramme.</i>
Azote in a state of nitrate.....	1.07	3.00
Phosphoric acid.....	0.40	4.10
Potash.....	3.66	150.00
Lime.....	48.00	70.50

Nile mud is formed essentially of the hydrated silicates of aluminum, iron, and potassium, composing a mixture of lime and organic matter.

BELGIUM.

Report from Antwerp.

ANTWERP, BELGIUM, *April 2, 1900.*

SIR: I have the honor to transmit herewith weekly abstract of bills of health issued at Antwerp, Belgium, during the week ended March